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Thermal and charge transport in low-doped cuprates at very low temperature

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Thermal and charge transport measurements were performed in the normal and superconducting states of ultra-pure samples of low- doped YBCO down to very low temperature. The normal ground state, whether accessed by varying doping or applying a magnetic field, is shown to be metallic. Upon cooling towards T=0, the thermal conductivity exhibits a finite residual linear term and the resistivity increases by only a modest amount, in stark contrast to what is observed in LSCO. The continuity of the residual linear term upon leaving the superconducting state points to a normal state with a nodal excitation spectrum. By directly comparing charge and heat conductivities as T $\rightarrow$0 we are able to perform a preliminary test of the Wiedemann-Franz law in underdoped cuprates.